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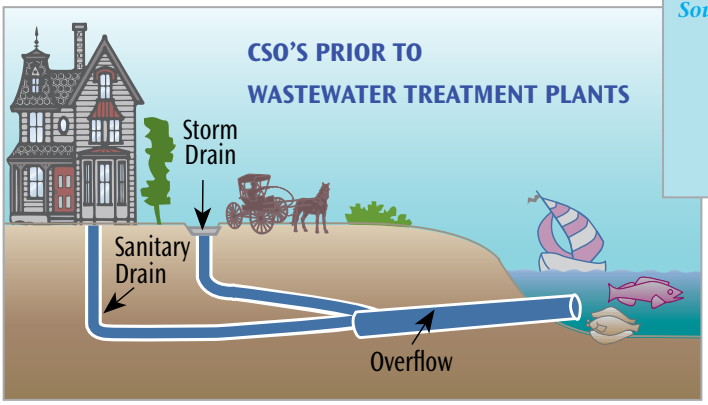
In Situ Water Quality Monitoring During the Denny Way CSO Sediment Remediation Project

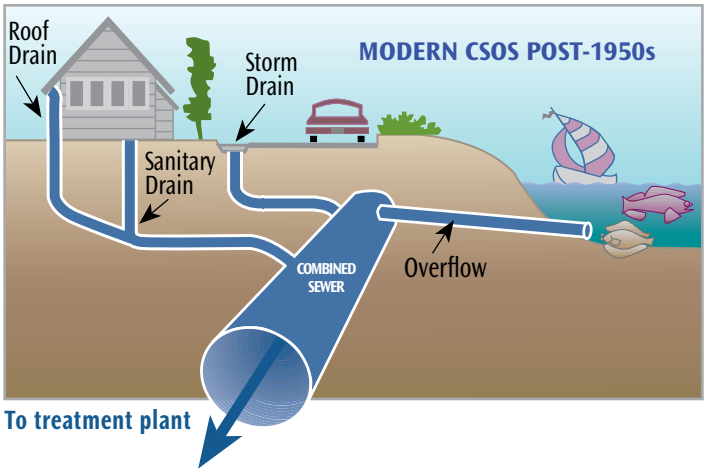
By Scott Mickelson, Senior Water Quality Project Manager

Introduction

CSO–or Combined Sewer Overflows–are discharges of untreated sewage and stormwater that are released directly into lakes, streams or marine waters during heavy rainfall when sewers have reached their capacity.

From the late 1800's, engineers designed combined sewers to carry sewage, garbage and horse manure from city streets combined with street and rooftop runoff from rainfall. This mixture was conveyed to the nearest receiving body of water. A CSO contains chemicals and disease-causing pathogens, and both CSOs and stormwater can be harmful to public health and aquatic environments.





Denny Way CSO

The Denny Way CSO was the largest in King County's wastewater treatment system, with frequent overflows during rain storms that exceeded system capacity. Overflows during lower tides would discharge directly onto the beach at Myrtle Edwards Park. The system was upgraded in 2005 and discharges were moved offshore. Legacy sediment contamination, however, required remediation in the nearshore area.

King County began sediment remediation in November 2007 through a combination of dredging and backfilling with clean material. Approximately 20,000 cubic yards of sediment, contaminated with PCBs, PAHs, phthalates, mercury, and silver, were dredged and transported for upland disposal. Clean backfill material was provided from routine maintenance dredging of the Duwamish River Turning Basin. After backfilling was complete, the area was armored using a coarse-grained material called habitat mix.

Washington State Department of Ecology regulations required monitoring turbidity and dissolved oxygen just outside of the construction mixing zone to determine whether construction activities were causing excursions beyond the applicable water quality criteria found in Chapter 173-201A of the Washington Administrative Code. King County opted to place an *in situ* ("in place") monitoring system at the site so water quality could be measured consistently and at a high frequency. This would allow county construction field staff to better supervise construction activities and institute best management practices if water quality was affected.

(Continued)

In Situ Water Quality Monitoring System

Electronic water quality monitoring sensors were mounted on a buoy at the construction site. High-frequency data were averaged every 15 minutes and uploaded through telemetry to a Web site. Since the water quality criteria for both turbidity and dissolved oxygen are relative to background, a reference station was established as a permanent sensor installation at the Seattle Aquarium.

The water quality monitoring system was comprised of YSI 6600EDS (Extended Deployment System). These instruments consist of a cylindrical pressure-resistant body with a cable connection on one end and temperature, conductivity, pressure, dissolved oxygen, turbidity and chlorophyll probes on the opposite end. An anti-fouling wiping system was used to prolong the calibration life and a "Rapid Pulse™" dissolved oxygen sensor removed the need for a stirring mechanism. This monitoring probe was deployed at the construction site on an offshore buoy and at the Seattle Aquarium in a permanent installation in the aquarium's pump house. The buoy, manufactured by Sound Ocean Systems, included an aluminum mast with sensor mounting plates, an autonomous mast light and radar reflector, and antifouling paint and rubber "rub-rails" at two heights.

YSI 6600EDS monitoring sensor.

Although the *in situ* monitoring system was designed to operate relatively autonomously, there were still monthly field activities necessary to maintain the integrity of the data. These included: Monthly maintenance; Monthly calibration; and Quality control, which included collection of water samples for laboratory analysis of dissolved oxygen and turbidity.

Sensors deployed on a buoy at the sediment remediation construction site.

Results

The use of *in situ* water quality monitoring instrumentation during the Denny Way CSO sediment remediation project provided King County with real-time turbidity and dissolved oxygen data that allowed instantaneous implementation of best management practices during dredging activities. Only one excursion above the turbidity water quality criterion was recorded during dredging activities. There were no excursions above the dissolved oxygen criterion.

Several excursions above the turbidity criterion were recorded during backfilling activities due to the amount of fine material in the "habitat mix" used as clean backfill. The real-time data was very useful in modifying the backfilling procedures.

Other benefits of the *in situ* water quality monitoring were: Acceptance of monitoring methodology by the Washington State Department Ecology; positive coverage in the local press; and inquiries for use of the instrumentation and buoy on other construction monitoring projects.

More information on CSOs can be found at: www.kingcounty.gov/environment/wastewater/CSO and http://cfpub.epa.gov/npdes/home.cfm.

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